An Explanation Method of Unfamiliar Tourist Spots based on Roles of User's Familiar Spots

Kenta Han and Daisuke Kitayama

***Abstract*—In recent years, when user plans to travel, users often use tourist information on the Web. However, travel often goes to an unfamiliar area, therefore it is difficult to get the tourist information properly. Therefore, in order to support understanding of users' unfamiliar spots, we propose a method to explain tourist spots of unfamiliar area using tourist spots that have visited by users. In this paper, at first, we generate the feature vector using user reviews of the tourist spot. Next, we use the relative feature vector compared with already visited spots to extract the role of the tourist spot for the user. Finally, we associate the visited spot with the unfamiliar spot by the similarity of the relative feature vector, and further extract keywords that explain the relation. We also develop the prototype system, and we evaluate the effect of the explanatory information between the familiar spot and the unfamiliar spot.**

***Index Terms*—tourist spots, explainability, user reviews, paragraph vector**

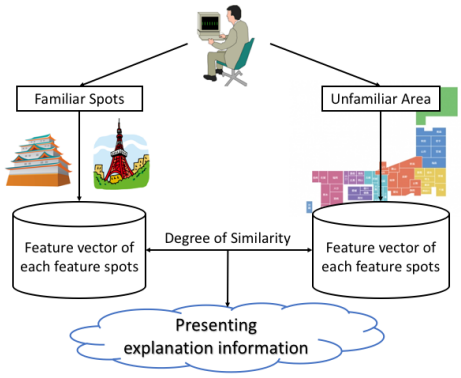

Fig. 1. An explanation method of unfamiliar tourist spots based on roles of user's familiar spots

I. Introduction

WHEN deciding the travel destination, the traveler selects tourist spots by planning a travel, browsing web pages of tourist spots and tourist guidebooks. However, travel often goes to an unfamiliar area, therefore it is difficult to get the tourist information properly. At this time, it is considered that the user often decides the tourist spot by looking at the ranking and recommendation information of the tourist spot search engine. In a tourist spot search engine such as Tripadvisor and Jalan, the user who visited there about a certain tourist spot posted reviews and there is a wealth of information on tourist spots. However, since the user has no prior knowledge about the search area, what kind of tourist spot is to be confirmed one by one.

Therefore, in order to effectively understand various tourist spots, we think that it is effective if we compare an unfamiliar spot using a visited spot of user. This is a kind of analogy that applies the matters that the user previously experienced to the current matter. In this case, the previous experience is the already visited spot and the current matter is the spot in the unfamiliar area. For example, whereas unfamiliar spots such as "Omotesando" in Tokyo, Japan, if you explain that it is similar to the already visited "Avenue des Champs-Elysees" in Paris, it may make it easier to understand.

In this paper, in order to support understanding of users' unfamiliar spots, we propose a method to explain tourist spots of unfamiliar area using tourist spots that have visited by users. In our method, the user inputs already visited spots and unfamiliar area. At this time, we generate the feature vector using user reviews of the tourist spot. Next, we use the relative feature vector compared with already visited spots to extract the role of the tourist spot for the user. Finally, we associate the visited spot with the unfamiliar spot by the similarity of the relative feature vector, and further extract keywords that explain the relation. By this way, we aim to rise understandability of unfamiliar spots. Fig. 1 shows a concept of the proposed method.

The structure of this paper is as follows. In section II, we introduce related works. In section III, we describe the proposed method. In section IV, we discuss evaluation experiments and its results. In section V, we describe conclusions of this paper and our future work.

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II. Related Work

A. Tourist spot retrieval and recommendation system

Many researches on retrieval and recommendation system using the user's experience history have been published. Kurashima et al.[1] proposed a travel route recommendation method using geotag information of photos posted to Flickr as a travel history of people. In this method, it is assumed that it is easy to move from a user's present location to a place easily accessible to the user's interest, and a behavior model is generated. That geotagged photo aggregation of users can be regarded as personal travel history when sorted by time information, and we generate user behavior model using geotag information. Kitamura et al.[2] proposed a method of recommending sightseeing spots based on estimating user's preferences of travel plan from past personal travel photographs using general object recognition. Using an object recognition system to acquire keywords of subject information taken in the photos and represented the co-occurrence of the keywords by a graph visualization technique. In addition, present a user interface that visualizes a graph with travel photos based on our graph visualization technique. Cheng

et al.[3] used photographs of freely available community contributions to focus on personalized trip recommendations, considering specific user profiles or attributes, suggested to consider personalized travel recommendations.

B. The analogy and its applications

Analogies were pointed out as contributing to creative thinking[4]. Analogical thinking works when acquiring a concept (called the target) from known knowledge (called the bases)[5]. Many of the researches on analogy are given the base learning data and targeted problems, and the problems are solved by mapping the features of things to the feature of the problem[6]. Gick et al. designed to investigate the use of analogies between disparate domains as a guide to finding solutions for an ill-defined problem. Some studied about how to give learning data and functions[7], and clarified whether to solve the problem depending on the degree of cognitive proficiency[8]. In many of the conventional research including these, after giving bases and targets for analogy, we solve problems according to a certain procedure. There are three types of structural similarities "similarity of object level" determined by the number of shared features, "relationship similarity" based on the degree of sharedness of relationships existing in the base and the relationship existing in the base, and similarity in the title solution or target level There is a certain "pragmatic similarity"[5], [9].

In the conventional method of using the user's experience history, many researches that analyze the geotag information of the history photograph and make it user's preference are performed. In addition, it is well used in learning support on analogy technology. In this research, using the review of familiar spots and unfamiliar spots, the relative features of each spot in each set of user familiar spot set and unfamiliar spot set are determined and associated, thereby supporting understanding of spots explanation information can be presented. Moreover, because the quality of analogy is treated explicitly, it is considered to be similar to the similarity of structure "similarity of relationship level" by this research.

III. An Explanation Method of Unfamiliar Tourist Spots

We propose an explanation method of unfamiliar tourist spots based on roles of user's familiar spots. At first, the user inputs a set of tourist spots that have been visited and tourist area that user wishes to visit. In our method, we generate the feature vector using user reviews of the tourist spot. Next, we use the relative feature vector compared with already visited spots to extract the role of the tourist spot for the user. Similarly, we calculate the relative feature vector of each tourist spot in the unfamiliar area by comparing with other tourist spots in that area. Then, we associate the visited spot with the unfamiliar spot by the similarity of the relative feature vector. Finally, we extract keywords that explain the relation.

A. Generating feature vector using user reviews of spot

In this paper, we will use the review data obtained from "Jalan"[1] until the end of September 2016. We generate

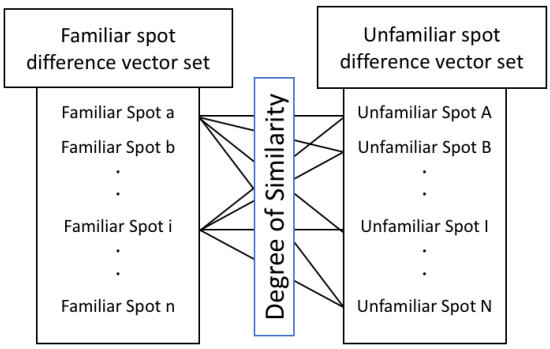

Fig. 2. Concept of similarity calculation

feature vectors of tourist spots using paragraph vector[**?**]. At this time, we combine all the reviews on a tourist spot and treat it as one document about the tourist spot. In this paper, we use gensim[2] that is a library of python for calculate paragraph vector. We used Distributed Bag-of-Words as a learning method, and the number of dimensions was 300. User reviews in Jalan are written by Japanese. Therefore, we use mecab[10] that is the Japanese morphological analyzer with dictionary "mecab-ipadic-NEologd"[3].

B. Relative features for role of tourist spots

In this research, features of tourist spots make use of relative features. We define that the relative feature is a unique feature when a tourist spot is compared with other tourist spots in a set of tourist spots. As an example, we consider the case where there are "Kinkakuji Temple" and "Kiyomizudera Temple" in the set of tourist spots. At this time, the features of "Kinkakuji Temple" are gold color, gold leaf, glow, and so on. On the other hand, the features of "Kiyomizudera Temple" are the stage, the womb inside, the panoramic view, and so on. Because both are temples existing in Kyoto, features related to Kyoto and temples do not appear as unique features. Next, we consider the case where "the Tokyo Metropolitan Government Building Observatories" and "Kinkakuji Temple" exist within the set of tourist spots. At this time, features of "Kinkakuji Temple" is Kinkakuji, a temple, golden color, Kyoto, and so on. On the other hand, features of "the Tokyo Metropolitan Government Building Observatories" is perspectives, night view, Shinjuku, and so on. If the categories of tourist spots are largely different, features as categories will appear. Also, it can show the features of the spot itself. In this research, when a certain spot compares with other spots in the set, we focus on the relative features that make it possible to clarify the features of each spot.

The relative feature vector $r_{state,i}$ is defined as formula 1. Is the value obtained by subtracting the average value of the spot vectors of the spots of the set of spots excluding the spot for which the relative feature vector is found. $S_{state} = \{s_1, s_2, \ldots, s_n\}$ is a familiar spot set or an unfamiliar spot set. When $state$ is $'f'$, it means familiar spot set. When $state$

[1]Jalan is a review posting site on tourist spots in Japan. https://www.jalan.net/kankou/

[2]https://radimrehurek.com/gensim/models/doc2vec.html

[3]https://github.com/neologd/mecab-ipadic-neologd/

is $'u'$, it means unfamiliar spot set. s_i is a feature vector of a tourist spot in the set S_{state}.

$$r_{state,i} = s_i - average(S_{state} - s_i) \quad (1)$$

C. Determination of explainable spot

From the relative feature vector $r_{f,i}$ of the familiar spot and the relative feature vector $r_{u,j}$ of the unfamiliar spot, the relative feature similarity between the familiar spot and the unfamiliar spot (Fig. 2). For the similarity calculation, use the cosine scale (formula 2).

$$cos(r_{f,i}, r_{u,j}) = \frac{r_{f,i} \cdot r_{u,j}}{|r_{f,i}| \times |r_{u,j}|} \quad (2)$$

A correlation between the familiar spot having similarity of each feature vector of the familiar spot and each feature vector in the unfamiliar area of 0.125 or more and the highest similarity and the unfamiliar spot is performed. In addition, there are two ways to establish an association between a familiar spot and an unfamiliar spot.

1) how to relate to unfamiliar spots based on familiar spots
2) how to relate to familiar spots based on unfamiliar spots

In the method 1, if the spot in the unfamiliar area holds a plurality of features when using the familiar spot as the base, there are cases where the spot is associated with the same unfamiliar spot. In method 2, method 2 is used as it is possible to extract features of each spot from the familiar spot set based on the unfamiliar spot and associate with the unfamiliar spot. In addition, in this research, we considered that it is reasonable to base on unfamiliar spots for explaining unfamiliar spots.

D. Extraction of explainable words for role

All tourist spots review words by using morphological analyzer "mecab-ipadic-NEologd". However, words obtained by using these words contain words that do not hold Japanese, and it is necessary to delete these noises. Specifically, delete particles, auxiliary verbs, rentaishi, symbols, stopwords.

We show the explanation information of the familiar spot and the unfamiliar spot associated in section III-C to the user as the set of keywords. We calculate the feature value of a keyword in a spot is defined by the formula 3.

$$TFIDF(t, d, state) = TF(t, d) \times log(\frac{|S_{state}|}{DF(t, state)}) \quad (3)$$

Where function $TF(t, d)$ returns the number of the word t in the document d. d is a document combining all reviews of a spot into one. Function $DF(t, state)$ retuns the number of documents that include keyword t. $|S_{state}|$ is the total number of spots.

In this method, for familiar spots, the user inputs plurality of spots. By considering all reviews of each spot as one document at a time and by considering all reviews of the other spots as documents, the TFIDF value is calculated by the formula 3, and use it as the feature words for each spot in the unfamiliar area.

Regarding the unfamiliar area, the user designates an area and inputs it. By considering all reviews of each spot in the area as one document and considering all reviews of the other spots as a document, the TFIDF value is calculated by the formula 3, and use it as the feature words for each spot in the unfamiliar area.

Fig. 3. Output interface

TABLE I
FAMILIAR SPOT GROUP AND UNFAMILIAR SPOT GROUP

Familiar Spot Name	Unfamiliar Spot Name
Sensoji Temple	Tokyo Disneyland (R)
Odawara-jo Park	Shinjuku Gyoen
Fushimiinari-taisha Shrine	Tokyo Skytree
Nara Park	Tokyo Tower Main Deck
Mishima Skywalk	Meiji Jingu

The explanation information on the associated familiar spots and unfamiliar spots associated with each other is determined by using harmonic averages according to feature words of each spot obtained by TFIDF. The harmonic mean is the reciprocal of the arithmetic mean of the reciprocal. We extract commonly appearing words in the review document of the familiar spot and the unfamiliar spot.The score of the extracted word is defined by the formula 4. $TFIDF(t, d, f)$ and $TFIDF(t, d, u)$ indicate the TFIDF value of the familiar spot and the TFIDF value of the unfamiliar spot, respectively. When the value of the word score is large, the TFIDF value of each of the familiar spot and the unfamiliar spot is large, that is, the word has high importance in each document. Therefore, the top ten words of the word score are presented to the user as explanation information (Fig. 3).

$$score(t, d) = \frac{2 \times TFIDF(t, d, f) \times TFIDF(t, d, u)}{TFIDF(t, d, f) + TFIDF(t, d, u)} \quad (4)$$

E. Example of explained unfamiliar spots

Table I is an example of a spot that a user has familiar spots and unfamiliar spots.

Unfamiliar spots are five spots randomly selected from within Tokyo. Table II shows the results of explaining the explanatory words using the proposed method in Section **??**.

Focusing on the feature of the park, it is thought that the spot closest to the park in the unfamiliar spot group is "Shinjuku Gyoen". In the set of familiar spots there are two parks, "Odawara-jo Park" and "Nara Park". "Odawara-jo Park" has a lot of descriptions about flowers and play equipments, and there are many descriptions for deers and grass at "Nara Park". Because "Shinjuku Gyoen" has a lot

TABLE II
EXPLANATION INFORMATION

Unfamiliar Spot	Familiar Spot	Explanation Information
Shinjuku Gyoen	Odawara-jo Park	flower viewing, bloom, inside the park, cherry-blossoms, carefree, care, nature, play equipment, azalea
Tokyo Skytree	Mishima Skywalk	mount fuji, tremor, high fear, trembling, ceiling, magnificent view, elevator, panorama, observation deck, rising

of descriptions about flowers and play equipments, it seems to be related to "Odawara-jo Park".

"Mishima Skywalk" has a view in the set of familiar spots, and it can be considered that the feature of the highest is the strongest. There are two of "Tokyo Skytree" and "Tokyo Tower Main Deck" that have good views with a high view in the unfamiliar spot group. "Tokyo Skytree" is thought to be "Mishima Skywalk" to its higher level, but "Mount Fuji" is included when I look at the explanation information. The height of the two spots is highlighted by the word "Mount Fuji". The proposed method can show the feature of each set of spots.

IV. EVALUATION EXPERIMENT

A. Settings of experiment

We compare absolute features and methods to present explanatory information by relative features of the proposed method. In addition, in the case of using relative features, we compare the method of calculating word scores using harmonic mean and the method of calculating word score using arithmetic mean.

We collected 24 subjects using CrowdWorks[4], a crowdsourcing service. We presented presentation information on unfamiliar spots by selecting subjects' familiar spots using tourist spots acquired by Jalan taking place. The patterns of explanatory information of absolute feature and relative features are as follows.

- A Absolute feature (category, duration time, season)
- B Absolute feature (feature vector)
- C Relative features (relative feature vector, harmonic mean)
- D Relative features (relative feature vector, arithmetic mean)

The explanation information A is narrowing-down information used for searching spots on the sightseeing spots search site. Three examples of narrowing down information are as follows.

- category: Shrine / Temple, Tourist facilities / Tourist tours etc.
- duration time: less than 1 hour, 1˜2 hour etc.
- season: 1˜12 month, spring, summer, autumn, winnter

First, using the familiar spot, we gradually narrow down the information in order of whether the categories with unfamiliar spot match, whether it matches the duration time or not, and whether or not it matches the season, and the familiar and the unfamiliar spot. Next, if there are multiple unfamiliar spots after squeezing, use the unfamiliar spot with the most review number. Finally, we extract the role words for explanation using section III-D and present them to the subjects. The explanation information B is the feature of each spot using the feature vector created in section III-A. The explanation information C is the proposed method. The explanation information D, explanation information on the familiar spot and the unfamiliar spot associated with each other is determined by using harmonic averages according to feature words of each spot obtained by TFIDF. We extracts commonly appearing words in the review document of the familiar spot and the unfamiliar spot. In addition, it is necessary for the extracted word to have an average value of the TFIDF values of the respective spots. The absolute value of the difference between the TFIDF value of the familiar spot word and the TFIDF value of the unfamiliar spot word is calculated as the word score and ten words whose word score is the closest to 0 are posted on the subject as explanation information.

First, the subjects have familiar spot, favorite spot and enter between 4 to 10. The subjects have selected from the search candidates as the input spots. For example,Shinjuku Gyoen—Shinjuku, Kiyomizudera—Kyoto etc. Next, the subjects never went on a trip etc and entered prefectures / areas that we would like to visit. Processing was carried out in the order of A to D of the pattern of explanation information, and the unfamiliar spot name, keyword, and familiar spot name were presented to the user, and one of the following 5 evaluations was selected.

1) No keyword
2) There is a relationship between the two spots in the first place, the relationship became clear by the keyword.
3) To the relationship of the two spots noticed for the first time by keyword.
4) There is a relationship between the two spots, but the keyword does not represent the relation.
5) There is no relationship between the two spots.

B. Result

Table III shows the number of data of each experimental result of explanation information A to D of Evaluations 1 to 5. In the evaluation experiment, the total of usable data is 394. The explanation information A has the smallest number of familiar spots associated with unfamiliar spots. The explanation information B has the largest number of familiar spots related to unfamiliar spots. The explanation information C and explanation information D, the association method between the unfamiliar spot and the familiar spot is the same, so the numbers are the same.

Table IV shows the ratio of the number of data of the experiment results as the evaluation 1 to 5 in the explanation information A to D. The explanatory information A presented to subjects, the unfamiliar spot and the familiar spot were originally related, and further clarified by presenting keywords. The explanatory information D thought that there was no relevance to the unfamiliar spot and the familiar spot, but since it was noticed for the first time by presenting the keyword to the subject, it is related to the proposed method of this research. In explanation information C and explanation information D, there are many proportions in which the

[4]https://crowdworks.jp/

TABLE III
STATISTICS ON THE NUMBER OF DATA OF EXPERIMENT RESULTS

Evaluation	Explanation information A	Explanation information B	Explanation information C	Explanation information D	Total
1	0	0	0	4	4
2	19	44	32	26	121
3	20	62	53	56	191
4	1	3	3	3	10
5	6	21	21	20	68
Total	46	130	109	109	394

TABLE IV
PERCENTAGE OF EVALUATION IN EXPLANATION INFORMATION

Evaluation	Explanation information A	Explanation information B	Explanation information C	Explanation information D
1	0.00%	0.00%	0.00%	3.67%
2	41.30%	33.85%	29.36%	23.85%
3	43.48%	47.69%	48.62%	51.38%
4	2.17%	2.31%	2.75%	2.75%
5	13.04%	16.15%	19.27%	18.35%

unfamiliar spot presented to the subject and the familiar spot are not related in the first place. In the four explanatory information patterns, only the explanatory information D has no keyword to present to the subject. Therefore, it can be said that in many cases it is possible to present keywords to subjects by using harmonic means. In addition, it can be shown that evaluation 1, evaluation 4 and evaluation 5 mean that explanation information is meaningless. Therefore, it can be said that explanation information D does not make the most sense.

From evaluation 1 and evaluation 2, the best case is to use categories that are unfamiliar spots presented to subjects and familiar spots in the first place. However, since the number of relevant spots is limited to categories, there are also few numbers that can be presented to subjects. In addition, it can not be said that unexpectedness can not be obtained because spot information of another category can not be presented to subjects. The second is to use the feature vector, the third to combine the relative feature vector and the harmonic mean, the combination which is not the best is the combination of the relative feature vector of the explanation information D and the arithmetic mean. Although the number of spots with relevance between explanation information C and explanation information D is the same, it can be said that the role of understanding support of keywords presented to subjects is reduced by calculating word scores using arithmetic mean.

Evaluation 2 is the combination of the relative feature vector and arithmetic mean, the combination of the relative feature vector and the harmonic mean is the second best, the third is the case where the feature vector is used, and the case where the category is not the best is used. Therefore, it can be said that a combination of a relative feature vector between the feature vector of the explanation information B and the explanation information C and a harmonic mean can show a good result. In addition, by using the relative feature vector, subjects have unexpectedness, and it is possible to present unfamiliar spots irrespective of categories.

For explanation information B and explanation information C, the case where the category of the familiar spot inputted by the examinee is different is similar to the case where the categories of the familiar spots input by the subject are different, the ratio of the evaluation of the evaluation 2 and the evaluation 3 is the table V. Using explanation information C, which is the proposed method, subjects can present meaningful keywords without relation to a certain spot that the subject has familiar visited. By using the relative feature vector, it can be said that the characteristics of each spot can be found over the category. In the case where the genres of the familiar visited spots are similar, the explanation information B is better than the case.

V. CONCLUSIONS AND FUTURE WORK

We focused on the difficulty of understanding the tourist spots searched by using the tourist spot search engine in ranking, recommendation information, categories, and so on., if the presented tourist spots are unfamiliar for the user. In order to support understanding of unfamiliar spots, we proposed an explanatory method to support understanding by comparing unfamiliar spots with familiar spots that users have already visited.

In the evaluation experiment, we evaluate four method of explanatory information. As a result, in the case of using categories, the number of familiar spots associated with unfamiliar spots is the smallest. In the case of using the relative feature vector and arithmetic mean, the role of supporting the understanding of keywords is the least. By using the relative feature vector and harmonic mean, the characteristics of each spot can be obtained. In addition, we confirmed that it was possible to correlate unexpected unfamiliar spots with familiar spots, and that there is a possibility that interest and attention can be drawn to tourist spots that users do not know.

As future works, we analyze experimental result such as the relevance between keywords presented to users. We also plan to evaluate the effectiveness and relevance of each keyword presented to the user.

ACKNOWLEDGMENT

This work was supported by ISPS KAKENHI of Grant-in-Aid for Scientific Research(C) Grant Number 18K11551.

REFERENCES

[1] T. Kurashima, T. Iwata, G. Irie and K. Fujimura., “Travel route recommendation using geotags in photo sharing sites”, CIKM ’10 Proceedings of the 19th ACM international conference on Information and knowledge management, pp.579-588, 2010

TABLE V
WHEN THE CATEGORIES OF THE FAMILIAR SPOTS ARE DIFFERENT OR PERCENTAGE OF EVALUATION WHEN SIMILAR

	When the familiar spots are different	When the familiar spots are similar
Explanation information B & Evaluation 1	56.82%	43.18%
Explanation information C & Evaluation 1	71.87%	28.13%
Explanation information B & Evaluation 2	51.61%	48.39%
Explanation information C & Evaluation 2	52.83%	47.170%

[2] R. Kitamura and T. Itoh, "Tourist Spot Recommmendation Applying Generic Object Recognition with Travel Photos", ITE Tech. Rep., Vol.42, No.12, AIT2018-94, pp.185-188, 2018

[3] A. J. Cheng, Y. Y. Chen, Y. T. Huang and Winston H. Hsu, "Personalized Travel Recommendation by Mining People Attributes from Community-Contributed Photos", MM '11 Proceedings of the 19th ACM international conference on Multimedia, pp.83-92, 2011

[4] K. J. Holyoak and P. Thagard, "Mental Leaps: Analogy in Creative Thought, MIT Press", Journal of Japanese Society for Artificial Intelligence, Vol.11, No.3, pp.489, 1996

[5] D. Gentner, "Structure-Mapping: A Theoretical Framework for Analogy", Cognitive Science, Vol.7, pp.155–170, 1983

[6] M. L. Gick and K. J. Holyoak, "Analogical Problem Solving", Cognitive Psychology, Vol.12, pp.306–355, 1980

[7] M. L. Gick and K. J. Holyoak, "Scheme Induction and Similarity in Analogical Transfer", Cognitive Psychology, Vol.15, pp.1–38, 1983

[8] Z. Chen and M. W. Daehler, "Positive and Negative Transfer in Analogical Problem-solving by 6-years-old Children", Cognitive Development, Vol.4, No.4, pp.327–344, 1989

[9] K. J. Holyoak and P. Thagard, "Analogical Mapping by Constraint Satisfaction", Cognitive Science, Vol.13, pp.295–355, 1989

[10] T. Kudo, K. Yamamoto and Y. Matsumoto, "Applying Conditional Random Fields to Japanese Morphological Analysis", Proceedings of the 2004 Conference on Empirical Methods in Natural Language Processing (EMNLP-2004), pp.230-237, 2004